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The Effect of Vertical Markets on Trade Policy Reform

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Introduction

Most applied policy analysis in agricultural economics typically ignores the existence of the food processing, distribution and retail sectors[1]. Of course, the existence of further links in the food system has received attention in the literature, but when the focus has been on policy issues, perfectly competitive markets have generally been assumed[2]. If these sectors actually were perfectly competitive, their exclusion would not significantly affect the welfare changes following policy reform, however, it is increasingly recognized that, to varying degrees, they are imperfectly competitive (Sutton, 1991), such that their exclusion might matter. In particular, there is a critical structural issue: what impact does imperfect competition at any stage of a multi-stage food system have on the extent to which changes in government policy affecting the farming/processing sectors are passed through to final consumers?

The aim of this paper is to consider how such factors affect the outcome of trade policy analysis. Using a model of a multi-stage food system which accounts for the existence of imperfect competition at each stage of a vertical marketing system, recent reforms to the European Community's (EC) banana import regime are examined. Emphasizing changes in consumer surplus, the analysis shows that ignoring market structure can exaggerate expected changes in consumer welfare, i.e. with imperfect competition, the marginal effects on consumer welfare that occur with trade policy reform are lower when markets are oligopolistic relative to the case where perfect competition is assumed. In addition, the distribution of changes in firms' profits due to policy reform varies in a vertical marketing system

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[1] The literature on the impact of the GATT Uruguay Round is fairly typical in this respect, e.g. Tyers and Anderson (1992).

[2] Much of the work on the farm-retail price spread has assumed both perfect competition and ignored intermediate stages of the food chain, e.g. Gardner (1975). An exception to this is Holloway (1991).

The paper is organized as follows: Section 1 outlines some key institutional details on changes in the EC banana regime and the structure of the banana industry, providing a background to the rest of the paper. A simple model of a multi-stage food chain is constructed in Section 2 capturing a number of characteristics of imperfect markets. From this model, a number of propositions are established in Section 3 that have important implications for evaluating the benefits from trade policy reform. These propositions suggest that the welfare gains from trade policy reform in the food and agricultural sector may be less than current estimates suggest.

A characteristic of the model used is that it can be calibrated with industry data so that counterfactual policy simulations can be conducted for a particular vertical marketing system. In Section 4 the model is calibrated to data for the European banana market which is characterized by the dominance of a small number of multinational firms at both the shipping and distribution stages, and high seller concentration at the retail level. The results indicate that a reduction in import tariffs to the UK sector will result in less than perfect pass-through to the consumer, a result that is sensitive to the nature of oligopolistic competition at the various stages of the banana marketing system. Also, because of imperfect price transmission, downstream firms are shown to capture some of the benefits of policy reform.

1. Institutional Background

In the past year, there has been considerable discussion of the EC's banana import regime. Under the Lomé Convention, the EC is formally obliged to ensure access to certain EC markets for banana exports from African, Caribbean and Pacific (ACP) countries and, in doing so, ensure

remunerative returns. Thus, the EC banana market has been highly segmented with the ACP countries having preferential access to the UK, French and Spanish markets. Banana exports from non-ACP countries (so-called "dollar" countries) have had limited access to these markets due to the use of quota restrictions. In contrast, other EC countries have operated different policies towards banana imports. These countries have imported largely from "dollar" countries and have operated an array of policies ranging from tariffs in the Netherlands and Belgium to a completely free market regime in Germany.

The overall effect of these policies has been to generate cross-country differences in the retail price of bananas (Fitzpatrick and Associates, 1990). Clearly with the advent of 1993, the persistence of different trade barriers and market segmentation in the EC would have been inconsistent with the aims of the European Single Market. Consequently, throughout much of 1992, proposals were discussed with the aim of reforming the EC banana regime in a manner consistent with unrestricted trade within the EC, but at the same time maintaining remunerative returns to ACP banana suppliers. On 17th December, 1992, following much debate, the issue was finally resolved: a tariff-quota scheme covering all banana imports into the EC was to be introduced in 1993 with the basic tariff level being 20 percent for the first two million tonnes of bananas with prohibitive tariffs on imports above this level (around 170 percent).

In the course of these discussions, there has been considerable economic analysis of this issue, the most notable papers being by Borrell and Yang (1990, 1992), and Borrell and Cuthbertson (1991). These papers have used non-spatial models of the EC banana market to derive expected welfare changes given various EC import policy scenarios. In particular, the focus in these studies has been on banana exporting countries rather than production in a

vertically-related distribution and retailing system involving private firms. In addition, these studies have assumed that the EC banana market is perfectly competitive.

However, neither assumption fits the facts. First, the sale of bananas is conducted through a complex, international, vertical marketing system, consisting of: plantation production (i.e. in Jamaica, Colombia and Ecuador); the wrapping and boxing of hands of green bananas; transportation via high-speed refrigerator vessels; large-scale ripening in the importing country; wholesale distribution and sale to final consumers through supermarket outlets. Second, various stages of this vertical marketing system can be characterized as imperfectly competitive. The key feature of the world banana export industry is the dominance of three multinational firms, United Brands (Chiquita), Standard Fruit (Dole), and Del Monte (see Read, 1983). Between them, these three firms account for 70 percent of the world market and 66 percent of the European market, United Brands alone accounting for 43 percent (Hallam and McCorriston, 1992). In addition, product differentiation through branding is a key feature of the retailing of bananas. For example, United Brands are reported to be able to sell their Chiquita brand at a price on average between 30 to 40 percent higher than its unbranded bananas (European Commission, 1976). Further evidence of market power in the EC is given by the European Commission's 1976 ruling against United Brands that it abused its dominant market position, and the commencement of a second inquiry into the firm's activities in 1990.

2. A Model of Vertically-Related Markets

In this section a model of a vertical marketing system is outlined that captures the basic characteristics of the banana import sector. The model is kept as simple as possible in order to

keep the derivations tractable and the results transparent. Consider the case of a two-stage marketing system, s = 1,2, comprised of a retail stage, s = 2, with an intermediate wholesaling stage s = 1, which processes/distributes an imported agricultural commodity, i.e. unripened bananas. Import prices are assumed to be determined exogenously, while stages s = 1,2 are characterized by oligopolistic market structures. The product sold to consumers is differentiated at the retail stage (i.e. banana branding), while the unprocessed/semi-processed product (i.e. ripened bananas) is assumed to be homogeneous at wholesale.

Since the theoretical model will be used to describe multilateral reform of trade policies, it is assumed that semi-processed products are not tradeable, while the final product is. The retailing (downstream) stage is linked to the wholesaling (upstream) stage through a fixed proportions, constant costs technology whereby output from the upstream stage is combined with other retailing inputs[3]. For second-stage firms, who are divided into two sectors i = 1,2, the output relationship can be written in the following form originally suggested by Greenhut and Ohta (1979):

$$Q_{2i} = \phi_i Q_{1i} \qquad i = 1,2 \tag{1}$$

where Q_{2i} and Q_{1i} are outputs of the third and second stages respectively, and ϕ_i is the constant coefficient of production, representing the share of Q_{1i} used in production at the second stage.

For institutional reasons, it is assumed that firms in sector i at stage one only supply the intermediate good to firms in sector i at stage two. (One can think of this in the banana case as two vertical marketing chains, one supplying ACP bananas, the other "dollar" bananas, where there is no trade in non-branded bananas, but trade at retail in ripened, branded bananas). In

[3] Previous work on the farm-retail price spread has assumed fixed proportions (Heien, 1980; Kinuccan and Forker, 1987). This is also a reasonable assumption for describing the marketing of bananas.

addition, it is assumed that first-stage firms exercise no monopsony power with respect to imports, and second-stage firms take the price of stage-one output as given, i.e. there is arms' length pricing.

In order to describe the structure of demand at the second stage, a differentiated duopoly, similar to that adopted by Cheng (1988), Dixit (1988), and Singh and Vives (1984), is used. This model has the attraction that it utilizes a general conjectural variations approach so that a wide class of oligopolistic structures can be captured. In terms of consumer demand, other sectors of the economy can be regarded as a competitive *numeraire* so that the consumer's utility function is linear and separable in the *numeraire*. Thus income effects can be ignored and partial equilibrium analysis can be conducted. The representative consumer maximizes:

$$U(Q_{2i}) - \sum_{i=1}^{2} p_{2i}Q_{2i} \qquad i = 1,2 \tag{2}$$

where Q_{2i} and p_{2i} are the amount and price of each product respectively at the second stage, and $U(Q_{2i})$ is given by:

$$U(Q_{21},Q_{22}) = a_1Q_{21} + a_2Q_{22} - (b_1Q_{21}^2 + b_2Q_{22}^2 + 2kQ_{21}Q_{22})/2 \tag{3}$$

where (3) is quadratic and concave, and the parameters a_i and b_i are assumed positive. Maximizing expression (2) generates the inverse demand functions for product i at stage two:

$$p_{21} = a_1 - b_iQ_{21} - kQ_{22} \tag{4}$$

$$p_{22} = a_2 - b_2Q_{22} - kQ_{21} \tag{5}$$

where $b_1b_2 - k^2$ represents the degree of product differentiation at the final stage. If $b_1b_2 - k_2 > 0$, the products are imperfect substitutes; if $b_1b_2 - k^2 = 0$ the goods are perfectly substitutes; and if $k = 0$ the goods are independent.

On the supply side at the second stage, there are n_{2i} symmetric-sized firms in the two sectors. Profits for a representative firm in each sector are given by:

(6) $$\pi_{21} = (p_{21} - p_{11} - c_{21})q_{21}$$

(7) $$\pi_{22} = (p_{22} - p_{12} - c_{22})q_{22}$$

where p_{1i} is the price firms at stage one charge for the semi-processed product, and c_{2i} are other stage-two costs. Since there are n_{2i} firms in each sector at the second stage, such that aggregate output is given by $Q_{2i} = (n_{2i}q_{2i})$, the first-order conditions for profit maximization are given as:

(8) $$p_{21} - p_{11} - c_{21} - Q_{21}V_{21} = 0$$

(9) $$p_{22} - p_{12} - c_{22} - Q_{22}V_{22} = 0$$

where the aggregate conjectural variations parameters V_{2i} are given as:

(10) $$V_{21} = [b_1(1 + (n_{21} - 1)v_{211}) + kn_{22}v_{212}]/n_{21}$$

(11) $$V_{22} = [b_2(1 + (n_{22} - 1)v_{222}) + kn_{21}v_{221}]/n_{22}$$

where the v_{2ii} ($i = 1,2$) are the firms' conjectures about how competitors in both parts of stage three will respond to a change in quantities. The values for the v_{2ii}'s are continuous variables whose values capture a range of possibilities concerning firm behavior. For example, if firms play Cournot strategies, then all v_{2ii}'s will equal zero; hence the value of V_{2i} will equal b_i / n_{2i}. For conduct more (less) competitive than Cournot, $v_{2ii} < 0$ (> 0). In the limit, either $v_{2ii} = -1$, the competitive outcome, or $v_{2ii} = 1$, the collusive outcome. Clearly firms can hold different conjectures about their competitors in the two sectors of stage three.

In order to conduct comparative statics exercises in this vertical system, it is necessary to establish the initial Nash equilibria of both stages. In the case of stage two, this is done by combining the inverse demand functions (4) and (5) with the first-order-conditions (8) and (9), to give:

$$\begin{bmatrix} Q_{21} \\ Q_{22} \end{bmatrix} = \frac{1}{\Delta'} \begin{bmatrix} b_2 + V_{22} & -k \\ -k & b_1 + V_{21} \end{bmatrix} \begin{bmatrix} a_1 - p_{11} - c_{21} \\ a_2 - p_{12} - c_{22} \end{bmatrix} \tag{12}$$

$$\begin{bmatrix} p_{21} \\ p_{22} \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} - \frac{1}{\Delta'} \begin{bmatrix} \Delta + b_1 V_{22} & kV_{21} \\ kV_{22} & \Delta + b_2 V_{21} \end{bmatrix} \begin{bmatrix} a_1 - p_{11} - c_{21} \\ a_2 - p_{12} - c_{22} \end{bmatrix} \tag{13}$$

where $\Delta = (b_1 b_2 - k^2)$ and $\Delta' = (b_1 + V_{21})(b_2 + V_{22}) - k^2$.

Turning to the first stage of the vertical chain, s = 1, the inverse (derived) demand functions for the upstream product from each sector, i = 1,2, of stage two, are defined by re-arranging expressions (8) and (9). Recalling (1), we have:

$$p_{11} = a_1 - (b_1 + V_{21})\phi_1 Q_{11} - k\phi_2 Q_{12} - c_{21} \tag{14}$$

$$p_{12} = a_2 - (b_2 + V_{22})\phi_2 Q_{12} - k\phi_1 Q_{11} - c_{22} \tag{15}$$

Profits for a representative firm at stage one, in each sector, can be written as:

$$\pi_{11} = (p_{11} - p_{m1} - c_{11})q_{11} \tag{16}$$

$$\pi_{12} = (p_{12} - p_{m2} - c_{12})q_{12} \tag{17}$$

where p_{mi} is the price that firms at stage one pay for the imported commodity, and c_{1i} are other stage-one production costs. The latter may include the cost of any tariff imposed on the imported agricultural commodity. Since there are n_{1i} symmetric-sized firms in each part of stage one, such

that aggregate output can be given as $Q_{1i} = (n_{1i}q_{1i})$, the first-order conditions for profit maximization can be written as:

(18) $$p_{11} - p_{m1} - c_{11} - \phi_1 Q_{11} V_{11} = 0$$

(19) $$p_{12} - p_{m2} - c_{12} - \phi_2 Q_{12} V_{12} = 0$$

where the aggregate conjectural variations parameters V_{1i} are given as:

(20) $$V_{11} = [(b_1 + V_{21})(1 + (n_{11} - 1)v_{111}]/n_{11}$$

(21) $$V_{12} = [(b_2 + V_{22})(1 + (n_{12} - 1)v_{122}]/n_{12}$$

where V_{2i} is as previously defined, and v_{1ii} are the stage-one firms' conjectures about how their competitors will respond to a change in quantities. Note that, since no trade in intermediate goods has been assumed, the cross-conjectures v_{1ij} between the two sectors of stage one are not defined as there is no direct competition. Also, the expressions for stage-one conjectures incorporate the relevant terms for stage-two conjectures. The first-order conditions (18) and (19) can now be re-written as:

(22) $$\Lambda_{11} - \beta_{21}\phi_1 Q_{11} - k\phi_2 Q_{12} - C_{11} - \phi_1 Q_{11} V_{11} = 0$$

(23) $$\Lambda_{12} - \beta_{22}\phi_2 Q_{12} - k\phi_1 Q_{11} - C_{12} - \phi_2 Q_{12} V_{12} = 0$$

where $\Lambda_{1i} = (a_i - c_{2i})$, $\beta_{2i} = (b_i + V_{2i})$, and $C_{1i} = (c_{1i} + p_{mi})$.

Utilizing the inverse demand functions (14) and (15), and the first-order conditions (22) and (23), and assuming $\phi_1 = \phi_2$, the initial Nash equilibria for the first stage of the system can be written as:

(24) $$\phi\begin{bmatrix} Q_{11} \\ Q_{12} \end{bmatrix} = \frac{1}{\Delta''}\begin{bmatrix} (b_2 + V_{22} + V_{12}) & -k \\ -k & (b_1 + V_{21} + V_{11}) \end{bmatrix}\begin{bmatrix} \Lambda_{11} - C_{11} \\ \Lambda_{12} - C_{12} \end{bmatrix}$$

$$(25) \qquad \begin{bmatrix} p_{11} \\ p_{12} \end{bmatrix} = \begin{bmatrix} \Lambda_{11} \\ \Lambda_{12} \end{bmatrix} - \frac{1}{\Delta''} \begin{bmatrix} \beta_{21}\beta_{12} - k^2 & kV_{11} \\ kV_{12} & \beta_{22}\beta_{11} - k^2 \end{bmatrix} \begin{bmatrix} \Lambda_{11} - C_{11} \\ \Lambda_{12} - C_{12} \end{bmatrix}$$

where β_{2i}, Λ_{1i}, and C_{1i} are defined as above, $\Delta'' = (b_1+V_{21}+V_{11})(b_2+V_{22}+V_{12})-k^2$, and $\beta_{1i} = (b_i + V_{2i} + V_{1i})$.

3. Vertical Markets and Trade Policy Reform

The hypothesis that there will not be complete pass-through to consumers of changes in upstream prices in a vertical marketing system is not entirely new. Colman (1988) has suggested that perfect transmission of agricultural policy prices is unlikely to occur for several reasons, e.g. the form of the policy intervention, and differences between the elasticity of supply at the farm-gate and the processing level (see Gardner, 1975). In addition, other empirical analysis suggests that slow transmission of changes in agricultural prices might have something to do with imperfectly competitive marketing intermediaries (Kinuccan and Forker, 1987). However, no analysis has focused explicitly on how imperfect competition might affect price transmission.

Consider the effects of trade policy reform in the vertically-related market outlined. Unlike standard welfare analysis, which assumes a one-for-one change in farm and consumer prices (i.e. there is perfect price transmission), in this framework trade policy reform affects costs of the stage one firms, which subsequently reduces the costs of stage two firms, and only then consumer prices. The determinants of the final effect on consumer prices are stated in the following proposition:

> *Proposition 1:* The degree of price change for final consumers following a change in import prices depends on: (i) the degree of product differentiation

between final goods; (ii) firm behavior at each vertical stage; and (iii) the number of firms at each vertical stage.

Using (13) and (25), and focusing for convenience on prices of final goods in sector i = 1, the effect of a change in p_{mi} is given by:

$$(26) \qquad \frac{dp_{21}}{dp_{m1} + dp_{m2}} = \frac{1}{\Delta' \Delta''}\{(\Delta + b_1 V_{22})[(\beta_{21}\beta_{12} - k^2) + kV_{11}] + kV_{21}[kV_{12} + (\beta_{22}\beta_{11} - k^2)]\}$$

where β_{2i}, β_{1i}, V_{2i}, V_{1i}, Δ, Δ', Δ'', are defined as above.

The best way to highlight the role of each of the determining parameters is to assume particular values for them. Take, first of all, the role of product differentiation at the second stage and firm behaviour at each vertical stage. Assume two extremes regarding product differentiation, ie. the products are perfect substitutes ($\Delta = 0$) or that they are independent ($k = 0$). Further, consider three types of firm behaviour (assumed to be the same at each stage): Cournot (v_{sii}, $v_{sij} = 0$, v = 1,2, the number of vertical stages), behaviour more competitive than Cournot (v_{sii}, $v_{sij} = -0.5$), and behaviour less competitive than Cournot (v_{sii}, $v_{sij} = 0.5$). (The number of firms at each stage in each sector is initially set equal to two.) The degree of price transmission (the change in final goods' prices) is summarized in Table 1[4].

Table 1 suggests that as behaviour becomes more competitive the degree of price transmission increases no matter the degree of product differentiation. Thus with two vertical stages, and Cournot behaviour, for a one unit change in import prices, with the final goods being independent, consumer prices would fall by only 0.444. With more competitive behaviour, final

[4] Certain values of b_1 and b_2 have to be assumed. The values chosen, arbitrarily, were $b_1 = b_2 = 0.05$. When the goods are perfect substitutes, k also equals 0.05.

prices would fall by a greater extent; with v_{sii} and v_{sij} = -0.5, final prices fall by 0.627. However, the degree of pass-through is also influenced by the degree of product differentiation. Assuming Cournot behaviour with independent goods, a one unit reduction in price support reduces consumer prices by a factor of 0.444; with perfect substitutes, consumer prices would fall by a factor of 0.615.

Table 1: Trade Policy Reform and Price Transmission[1]

	$\Delta = 0$	$k = 0$
Behaviour more competitive than Cournot (v_{ii}, v_{ij} = -0.5)	0.790	0.627
Cournot behaviour (v_{ii}, v_{ij} = 0)	0.615	0.444
Behaviour less competitive than Cournot (v_{ii}, v_{ij} = 0.5)	0.487	0.327

[1] Two vertical stages and two firms in each sector at each stage

The results in Table 1 assume that the number of firms at each sector and in each stage equals two. However, as the number of firms at any given stage increases, then equilibrium approaches the competitive outcome. Since Table 1 suggests that more competitive behaviour increases price transmission, one would also expect this to be true when the number of firms at any (or all) stage(s) increases.

The implication of imperfect price transmission following changes in trade policy resulting from the vertical market structure is that the changes in consumer surplus will be lower than that

commonly measured by conventional analysis. Thus, for example, if import tariffs are reduced, then - with a vertical market structure - the increase in consumer surplus will be less than traditionally measured. However, as output price changes are less than proportionate to cost changes that trade policy reform generates, the reform will also affect firms' profits at each vertical stage. Thus, for example, reducing import tariffs leads to relatively lower increases in consumer surplus but also increases firms' profits in the intermediate stages. However, the change in profits will depend on the vertical stage in which the firm competes. Approximating, for simplicity, profits with price-costs margins, the effects of trade policy reform on firms at each stage is stated formally in the following proposition:

> *Proposition 2*: With trade policy reform, changes in price-cost margins are greater (less) for those firms competing in a vertical stage closest to the consumer (point of import).

Focusing on prices in sector i=1, it can be noted from (13) and (25) that:

$$\frac{dp_{21}}{dp_{11} + dp_{12}} = \frac{1}{\Delta'}(\Delta + b_1 V_{22} + k V_{21}) \leq 1. \tag{27}$$

$$\frac{dp_{11}}{dp_{m1} + dp_{m2}} = \frac{1}{\Delta''}(\beta_{21}\beta_{12} - k^2 + k V_{11}) \leq 1 \tag{28}$$

where all variables are defined as above. If there is imperfect competition, and hence imperfect pass-through, (27) and (28) will both be less than one. This means that as costs fall, output prices at each vertical stage will fall, but by less than the reduction in costs, i.e. price-cost margins increase. However, the increase in price-cost margins will vary by vertical stage.

Taking (27) and (28), and rearranging, the ratio of stage-two to stage-one price changes in sector i=1 is given as:

$$(29) \qquad \frac{dp_{21}}{dp_{11}} = \frac{\Delta''(\Delta + b_1 V_{22} + k V_{21})}{\Delta'(\beta_{21}\beta_{12} - k^2 + k V_{11})} < 1$$

and because price transmission is less at stage two than stage one, (29) is less than 1, i.e. the price-cost margin at stage two increases by more than that at stage one, thus the distribution of the change in profits varies in a vertical marketing system.

4. Calibration and Policy Simulation

In order to explore the significance of accounting for market structure in trade policy analysis, the welfare changes resulting from the new EC banana regime were derived using a simulation version of the above model for the UK banana market. Prices in the UK have been affected by import quota restrictions on non-ACP suppliers, and have, therefore, been relatively high, the tariff-equivalent of pre-1993 restrictions being 34 percent above world market prices. With the new EC common external tariff of 20 percent, the tariff-equivalent differential should have fallen by 14 percent. Because the change in EC policy has been targeted at banana imports, the analysis focuses on stage one wholesaling firms who face a change in the tariff levied on the price of landed, unripened bananas, p_{mi}, i = 1,2, which is then passed on to retailers. In its simplest form, the non-cooperative game at stages one and two is assumed to be played by wholesalers and retailers of ACP bananas (Q_{si}, s = 1,2) competing with wholesalers and retailers of non-ACP bananas (Q_{sj}, s = 1,2).

Conducting a policy simulation of this type involves calibrating the model in a manner similar to computable general equilibrium models[5]. Essentially, external values of the own-price elasticity, ε, and the elasticity of substitution, σ, between ACP and non-ACP bananas, combined with observations on banana prices and quantities at the final stage of the vertical chain are required to solve a system of equations in order to derive values for the parameters of the demand system. The conjectural variations parameters for each stage are calculated directly from the relevant first-order conditions at each stage, given data on prices, quantities and costs.

While this method has the advantage of only requiring a limited amount of data, it is open to the criticism that the results may be highly sensitive to the data used in the calibration, particularly the value for the elasticity of substitution. To deal with this criticism, the model was calibrated in the following manner: upper and lower values for the elasticity of substitution were chosen, and, between these bounds, values of the elasticity are assumed to be uniformly distributed. A random number generator (utilizing 40,000 draws) is then used to draw from this distribution, and, as a result of this process, a distribution of outcomes for the model's parameters is generated, and, hence, a distribution of the pass-through and welfare effects. The results reported in the paper, therefore, are based on mean values.

The model was calibrated with UK banana market data from in 1989. The data used for the calibration procedure are reported in Table 2. Prices and quantities for the various stages of the banana marketing system were taken from UK Ministry of Agriculture statistics. The price elasticity of demand for bananas in the UK, ε, was based on similar estimates for the UK and other developed countries reported in studies by the World Bank (1985), Islam and Subramian

[5] This particular technique was originally pioneered by Dixit (1987).

(1989), and Huang (1993). In the case of the elasticity of substitution between ACP and non-ACP bananas, the range for σ was set at 0.5 to 5.0.

Table 2: Calibration Data (1989)

Variable	ACP Bananas	Non-ACP Bananas
Q_{si} (tonnes)	316,000	104,000
P_{2i} ($/tonne)	1,728	1,728
P_{1i} ($/tonne)	1,039	1,081
P_{mi} ($/tonne)	722	638
ε	0.4	
σ	0.5-5.0	

Source: See text.

Table 3: Calibrated Parameters[1]

Parameter	ACP Bananas	Non-ACP Bananas
a_i	6048	6048
b_i	1.191^{-2}	2.530^{-2}
k	5.342^{-3}	
$b_1b_2 - k^2$	1.613^{-6}	
V_{2i}	2.180^{-3}	6.221^{-3}
V_{1i}	1.003^{-3}	4.260^{-3}

[1] All parameter values, except the conjectural variations, are based on mean values

The results of the calibration procedure are reported in Table 3, giving mean values of the parameters of the inverse demand functions (4) and (5), values for the conjectural variations parameters at both stages of the vertical marketing system, and the mean degree of product

differentiation between ACP and non-ACP bananas. The computed values of the conjectural variations parameters imply the banana marketing system is less than perfectly competitive at each stage, with some degree of product differentiation between ACP and non-ACP bananas at the retailing stage.

Given values of b_i, k, and V_{si}, derived from the calibration procedure, pass-through to UK consumers of changes in the level of banana import tariffs can be calculated from (26), and from this changes in consumer welfare are then derived, the results being reported in Table 4.

Table 4: Price Transmission and Welfare Changes Following Changes in EC Banana Regime: Effects of Market Structure[1]

	Degree of Pass-Through (%)		Change in Consumer Surplus ($m)	Change in Consumer Surplus as % of Competitive Case
Market Structure	p_{21}	p_{22}		
Actual Behavior	0.810 (0.809-0.811)	0.801 (0.797-0.803)	83.959 (83.950-83.960)	0.80
Perfect Competition	1.00	1.00	104.45 (104.450-104.500)	-

[1] Mean values, figures in brackets are the lower and upper bounds respectively

Ignoring imperfect competition, the degree of pass-through would be 1.00, i.e. the 14 percent fall in tariffs in the UK banana market would be fully transmitted to consumers. This would result in a US $104.45m increase in surplus for consumers. However, with actual behavior, which is less than perfectly competitive, the degree of price transmission is less, as are the estimated changes in consumer surplus. Actual behavior implies a degree of pass-through

of 0.80, which would generate an increase in consumer surplus of US $83.959m, which is 20 percent less than the competitive case.

The impact on firms' profits of the trade policy reform was also simulated, the results being reported in Table 5. These indicate that the degree of pass-through at stage one averages 0.92, which exceeds that at stage two of 0.86. Also, profits at stage one increase by only $5.324m compared to $10.605m at stage two[6]. These results confirm that food wholesaling and retailing firms capture some of the benefits of the reduction in banana import tariffs, although these benefits are not evenly distributed among the two stages of the vertical chain.

Table 5: Price Transmission and Firms' Profits[1]

	Degree of Pass-Through (%)		Change in Firms' Profits ($m)[2]
	P_{21}	P_{22}	
Stage 2	0.862 (0.862-0.863)	0.869 (0.868-0.870)	10.605 (10.000-11.250)
	P_{11}	P_{12}	
Stage 1	0.940 (0.940-0.941)	0.919 (0.917-0.920)	5.324 (5.000-5.680)

[1] Mean values, figures in brackets are the lower and upper bounds respectively

[2] Profits are summed over both sectors i = 1,2.

[6] It is interesting to note that, compared to consumer surplus, firms' profits seem more sensitive to the value of the elasticity of substitution in the calibration.

5. Summary and Conclusions

In this paper, the effects, on policy outcomes, of vertically-related markets where there is imperfect competition at each stage, have been explored. Most agricultural economics analysis ignores vertical market linkages when assessing the effects of agricultural policy and trade reform. However, understanding the role of vertical market linkages is clearly important when focusing on processed food markets and, perhaps more critically, appreciating the significance of imperfect competition that often characterizes these sectors. By ignoring such characteristics, policy analysts are likely to over-estimate the degree to which consumer prices will change, and hence, the corresponding change in consumer welfare. This was highlighted with an application to changes in the EC banana regime, a market characterized by two main sources of supply and the existence of a few multinational firms. Depending on the nature of oligopolistic behavior, it was estimated that consumer surplus changes could be as much as 20 percent lower than estimates assuming perfect competition. In addition, due to imperfect pass-through, firms in the wholesaling and retailing stages of the chain capture some of the benefits of the reduction in banana import tariffs, the extent depending on the stage of the marketing system.

At this point, it is important to consider the directions in which this type of analysis could be extended. First, the vertical marketing system has been restricted to two stages. Although this was dictated in this paper by the point in the banana marketing system where policy intervention occurs, it is relatively easy to generalize the model to more stages. The net result of this is that pass-through in a vertical marketing system is inversely related to the number of vertical stages.

Second, while a vertical marketing system is modelled, the nature of vertical market linkages has been restricted to simple arms' length pricing arrangements, where there are uniform posted prices. In practice, rather more complex, non-linear contractual arrangements such as two-part tariffs and exclusive dealing are often observed. For example, in the case of the banana market, the European Commission's 1976 ruling against Chiquita involved that firms attempt to use exclusive dealing arrangements with EC banana ripeners. Although these type of vertical restraints have not been allowed for in the model, the economic theory of such restraints would suggest two ways in which they might affect pass-through[7]. If such restraints are aimed at removing vertical inefficiencies such as double marginalization, they are likely to result in greater pass-through effects than simple linear pricing, however, if their objective is to facilitate collusion among downstream firms, then they may result in lower pass-through.

The question that has been pursued in this paper is whether vertical markets and market structure issues matter in policy analysis? They do. Consequently, this creates an obvious agenda for future research, particularly in terms of developing vertical market models that capture the range of vertical contractual arrangements. Only by attempting to derive a more accurate representation of markets will a better perspective of the effects of policy reform emerge.

[7] See Katz (1989) for a thorough discussion of such restraints.

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